

Astronomy: Earth and Space Systems

8-4 The student will demonstrate an understanding of the characteristics, structure, and predictable motions of celestial bodies. (Earth Science)

8-4.5 Explain how the tilt of Earth's axis affects the length of the day and the amount of heating on Earth's surface, thus causing the seasons of the year.

Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: In 4th grade (4-3.4), students explained how the tilt of Earth's axis and revolution around the Sun resulted in seasons, but not the effect of direct or indirect rays of the Sun on the amount of heating that takes place.

It is essential for students to know that:

- The angle of the Sun's rays due to the position of Earth in its orbit, the tilt of Earth's axis, and the number of daylight hours causes the differences in the seasons.
- The number of daylight hours changes throughout the year because as Earth revolves around the Sun, the tilt of its axis (23½ degrees) determines the amount of time that the Sun is shining on that portion of Earth. The tilt remains at the same angle and points at the same direction as Earth revolves around the Sun.
- If the tilt of Earth is toward the Sun, there is a longer length of day, the season is summer. If it is neither tilted toward or away from the Sun, the length of day and night is equal, the season is fall and spring. If the tilt of Earth is away from the Sun, there is a shorter length of day, the season is winter.
- Earth has *seasons* because its axis is tilted in the same direction as it moves around the Sun not because of any distance difference between the Sun and Earth.
- The combination of direct rays from the Sun that strike Earth at higher angles (closer to 90 degrees) and more daylight hours causes the hemisphere of Earth tilted toward the Sun to have warmer temperatures.
- The combination of indirect rays from the Sun that strike Earth at lower angles and less hours of daylight in the hemisphere of Earth angled away from the Sun have cooler temperatures.
- The day when the tilt of Earth causes the length of day to be the longest or the shortest, a *solstice* occurs. This is the start of summer and winter.
- The day when the tilt of Earth causes the length of day and night to be equal, an *equinox* occurs. This is the start of spring and autumn.

NOTE TO TEACHER: Students may have a misconception about the distance between Earth and the Sun causing Earth to be warmer or cooler since their experiences have shown them that the closer something is to a heat source the warmer/hotter it gets. This is not the case with seasons on Earth.

It is not essential for students to know the specific dates that each season begins. Students might discuss the height of the Sun above the horizon at various seasons of the year, but it is not essential to this indicator.

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Assessment Guidelines:

The objective of this indicator is to *explain* the tilt of Earth's axis affects the length of the day and the amount of heating on Earth's surface, thus causing the seasons; therefore, the primary focus of assessment should be to construct a cause-and-effect model of how Earth's tilt results in varied daylight hours and unequal heating of Earth's hemispheres and seasonal change.

However, appropriate assessments should also require students to *interpret* diagrams of unequal heating resulting from the tilt; *illustrate* the position of Earth with its tilted axis at various seasons; or *recall* when solstices and equinoxes occur.